Description

Method for establishing a call in a telecommunications net-
work; telecommunications network; and controlling device for
5   packet networks

This application is related to and claims the benefit of com-
monly-owned U.S. Provisional Patent Application No.
60/551,586, filed March 09, 2004, titled "Method to Identify
10   Calls Between Remote VoIP Subscribers Connected via a Transit
PSTN and Reconnect as End-to-End VoIP" which is incorporated
by reference herein in its entirety.

The present invention relates to a method for establishing a
15   call in a telecommunications network, a telecommunications
network, and a controlling device for packet networks. More
particularly, the present invention relates to an optimized
method, network, and device for facilitating packet network
calls in mixed packet and TDM environments.
20
Modern communications networks generally carry two types of
traffic or data. The first is the traffic which is transmit-
ted by or delivered to a user or subscriber, and which is
usually paid for by the user. That type of traffic is widely
25   known as user traffic or subscriber traffic. The second is
the traffic caused by network management applications in
sending and receiving management data from network elements,
known as management traffic.

30   In telecommunications, the management traffic is also known
as signaling traffic. The term "signaling" refers to the ex-
change of signaling messages between various network elements
such as database servers, local exchanges, transit exchanges,
and user terminals. A well known protocol for transferring
35   such signaling messages in public switched telephone networks
(PSTN) is the Signaling System 7 (SS7), also referred to as
Common Channel Signaling System 7 (CCS7).

The Signaling System 7 as specified by the International
Telecommunication Union (ITU) in the Q.700-series standards
provides for all signaling tasks in today's voice-oriented
5   telecommunications networks. More specifically, SS7 provides
for example for:
- basic call setup, management, and tear down;
- enhanced call features such as call forwarding, calling
  party name/number display, and automatic callback (call
10   return);
- accounting and billing;
- database operations for services such as authentica-
  tion, roaming, toll-free and special tariff services,
  and number portability;
15 - network management for the SS7 network and its connec-
  tions; and
- non-call related signaling, allowing for services such
  as short message service (SMS), ISDN Supplementary Ser-
  vices and user-to-user signaling (UUS).
20
With the advent of "next generation" packet based telecommu-
nications networks, and internet protocol (IP) based networks
in particular, new signaling and bearer protocols were devel-
oped by the ITU and other standards bodies such as IETF,
25 ETSI, and 3GPP.

The functional architecture of such Next Generation Networks
(NGN) seeks to provide a technology independent architecture
for supporting multimedia services. The intention is to sup-
30 port a wide range of voice, data and video services while
providing inter-working with the legacy PSTN (Public Switched
Telephone Network) and cellular/wireless networks, also col-
lectively referred to as time division multiplex (TDM) net-
works, and/or with legacy devices.
35
Presently, PSTN-type, or TDM, networks dominate the voice te-
lephony globally. While the IP based networks and their te-

lephony applications by means of voice over IP (VoIP) proto-
cols are expanding, the PSTN-type networks – still adequate
for providing reliable voice services – will only gradually
lose their dominance. It is foreseen that the two network
5   types will coexist and inter-work in numerous ways in the
next decades.

In particular, the PSTN infrastructure will dominate long
distance and international calls. Consequently, many of the
10   rules and regulations established for PSTN operations will
prevail in mixed environments. This is particularly true for
uniquely addressing parties or their telecommunications
equipment, respectively. While IP networks are capable of
various forms of addressing a called party, for example by a
15   symbolic name such as an email address or a SIP Uniform Re-
source Identifier, a PSTN is only capable of handling tele-
phone numbers as laid out in numbering plans such as the ITU-
T E.164 international numbering plan.

20   If, for example, a PSTN subscriber wishes to establish a con-
nection to a subscriber of an IP network, the PSTN subscriber
has only one way of addressing the IP subscriber, that is, by
dialing digits, even though the IP subscriber may have the
name dialing capability. Therefore, IP subscribers who want
25   to be able to receive calls from PSTN subscribers need to be
assigned a regular PSTN directory number.

In another example, where a PSTN subscriber is represented
within the IP network by a name, and the IP subscriber can
30   address this PSTN subscriber by name, prior to presenting
this call to a PSTN switch, the name has to be converted to
digits. Of course, the PSTN subscriber may instead or addi-
tionally be addressed from within the IP network by regular
PSTN directory number.
35
Consequently, if a first subscriber of a first IP network
wishes to call second subscriber, it will be necessary for

the first subscriber to use digits in order to route the call
in the PSTN-dominated inter-working network arrangement. If
the second subscriber is subscriber to a second IP network,
then traversing the PSTN provides no benefit but rather lim-
5   its the connection capabilities to the PSTN capability set,
i.e. none of the advanced IP network features such as ex-
changing data, images or video will be available even though
both subscribers are, in fact, IP subscribers.

10   There are various other scenarios where a connection between
two IP subscribers inevitably and undesirably traverses a
PSTN network section at least once.

It is therefore an object of the present invention to provide
15   a novel method for establishing calls in a mixed PSTN/IP en-
vironment. It is a further object of the invention to provide
a novel network arrangement facilitating calls in a mixed
PSTN/IP environment. It is yet another object of the inven-
tion to provide a novel network node for supporting calls in
20   a mixed PSTN/IP environment.

In accordance with the foregoing objectives, there is pro-
vided by the invention a method for establishing a call in a
telecommunications network, the telecommunications network
25   comprising a first and a second packet network section, a TDM
transit network section coupled to the first and second
packet network sections, and a wide area packet network cou-
pled to the first and second packet network sections. The
method comprises the steps of:
30   -   providing, at a first terminal equipment coupled to said
first packet network section, dialed digits, the dialed
digits representing a directory number of a second termi-
nal equipment coupled to said second packet network sec-
tion;
35   -   initiating the setup of a first connection through the TDM
transit network to the second packet network in accordance
with said dialed digits, wherein during call setup at

least one message or information element is conveyed to
the second packet network section, the at least one mes-
sage or information element being indicative of the first
terminal equipment's packet capabilities and/or an address

5   of a first controlling device controlling the call in the
first packet network section;
-   in the second network, receiving said at least one message
or information element at a second controlling device con-
trolling the call in the second packet network section;

10   and
-   establishing, by means of the first and second controlling
device and the information extracted from said at least
one message or information element, a second connection
between the first and second terminal equipment through

15   the wide area packet network.

In a preferred embodiment, TDM transit network section re-
sources utilized during call setup through the TDM transit
network are released once the at least one message or infor-

20   mation element was transferred.

In another preferred embodiment, the at least one message or
information element is further indicative of a vendor of said
first terminal equipment. This is useful to allow detection

25   of the vendor of the first terminal equipment in the second
network to enable additional vendor specific features and
services if, for example, the vendor of the first terminal
equipment is also the vendor of the second terminal equip-
ment. In general, the vendor information may be used to indi-

30   cate the compatibility of terminal equipment with a set of
non-standard features and services to allow compatible termi-
nals to make use of such (end-to-end) features and services.

In another preferred embodiment, the at least one message or

35   information element is the user-to-user information (UUI) pa-
rameter or the application transport parameter (APP) of the
ISUP protocol. These two exemplary parameters allow the

transfer of several user specific information types and can,
for example, be part of the ISUP message IAM used for setting
up the first connection. These parameters may also be used in
the ISUP messages ACM and ANM to convey similar information

5   from the second to the first packet network section. Another
suitable parameter is known as the network transport parame-
ter. The network transport mechanism may be used to send in-
formation through the network transparently, without involv-
ing a call setup. The objective is to send parameters end-to-

10   end through the network, without the intermediate exchanges
having to process the message.

In an exemplary embodiment, the application transport parame-
ter may convey the first terminal equipment's packet capa-

15   bilities and/or the address of a first controlling device
controlling the call in the first packet network section en-
coded as ISDN subaddress.

According to the present invention there is also provided a

20   telecommunications network comprising means for executing the
inventive method. The invention further provides for a con-
trolling device suitable for packet networks capable of fa-
cilitating the inventive method.

25   One advantage of the present invention lies in its capability
to connect packet subscribers, for example, VoIP subscribers,
and their advanced terminal equipment via packet network in
situations where a calling packet network subscriber (and the
calling subscriber's serving network) is not aware of the

30   fact that the called subscriber is also a packet network sub-
scriber and the call is consequently established via a TDM
transit networks using dialed digits of a PSTN directory num-
ber assigned to the called subscriber.

35   This, in turn, avoids the multiple protocol conversions oc-
curring when handing the call data from the packet network to

the TDM network and back to the packet network, thus improv-
ing the quality of the overall connection.

Another advantage of the present invention is that by setting
5   up connections initially over a legacy TDM network, features
provided by this legacy network, such as number translation
or number portability services, can be provided to the call-
ing IP subscriber.

10   The invention further allows for releasing the TDM resources
once the packet network connection has been established, thus
reducing the load of the TDM network. Preferentially, only
two messages (the initial setup message, e.g. IAM, and its
response, e.g. ACM or REL) need to traverse the TDM network
15   to allow for connecting the packet subscribers via packet
network. The present invention also allows the subscribers to
use packet network features not supported by legacy TDM con-
nections, such as high-bandwidth, high-quality encoding of
voice and video, customized ringing, and visual caller ID.
20

Depending on regulation imposed by national or international
authorities, VoIP calls may be exempt from rigid regulation
governing TDM networks.

25   The present invention may advantageously be used in IP Cen-
trex environments where calling and called subscriber are
connected to different branch exchanges.

In the following, the invention will be described in more de-
30   tail in the form of advantageous embodiments which are better
understood in accordance with the enclosed drawings.

Fig. 1 shows a schematic representation of a network arrange-
ment in accordance with the invention, and a call flow,
35   wherein the call establishment is controlled by means of
gateways.

Fig. 2 shows a schematic representation of the network ar-
rangement of Fig. 1, and a call flow, wherein the call estab-
lishment is controlled by means of soft switches.

5   Fig. 1 shows an exemplary telecommunications network 100 in
accordance with the invention. Telecommunications network 100
comprises first and second packet network sections 110 and
120, which may be implemented as IP networks. A first packet
subscriber's terminal equipment 112 is serviced by the first
10 packet network section 110, and a second packet subscriber's
terminal equipment 122 is serviced by the second packet net-
work section 120. The packet network sections 110, 120 employ
various network nodes for providing services, such as soft
switches 114, 124 and TDM gateways 116, 126. By means of TDM
15 gateways 116, 126 both packet network sections 110, 120 are
coupled to a TDM network section 140, which may comprise TDM
switching equipment 142, 144 such as (tandem) switching of-
fices, signaling transfer points etc, as is well known in the
art. The TDM switching equipment 142, 144 and the interfaces
20 internal to the TDM network 140 may be based on TDM technol-
ogy or on Asynchronous Transfer Mode (ATM) technology.

Packet network sections 110, 120 are further coupled by means
of packet switching equipment 118, 128 to a wide area packet
25 network 130 such as the Internet. Packet switching equipment
118, 128 may comprise routers and switches, as is well known
in the art.

In the following, a sequence of events occurring in network
30 100 will be described with reference to numerals 1-10. It
shall be noted that numerals 1-10 do not indicate a complete
call flow but rather show general events, messages, and noti-
fications that facilitate the inventive method.

35 The procedure starts with subscriber A dialing subscriber B's
PSTN directory number using, for example, a keypad of first
terminal equipment 112, which may be an IP enabled telephone

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such as a SIP terminal, or any other IP-enabled terminal
equipment such as a PC with suitable software. The term "ter-
minal equipment" may also refer to gateways and other routing
equipment attempting to establish calls from first IP network

5   110 to second IP network 120 by utilizing the TDM network 140
routing capabilities.

In step 1, a corresponding setup message, for example a
SIP:INVITE message, is generated and provided to first soft

10   switch 114 by means of first packet network section 110.

In step 2, a call agent residing in first soft switch 114
propagates the call setup to first TDM gateway 116.

15   In step 3, first TDM gateway 116 sends a call setup message
to TDM network section 140 using any known TDM signaling pro-
tocol such as ISDN, ISDN User Part (ISUP), or Telephone User
Part (TUP). This call setup message generated by first TDM
gateway 116 contains any information element or parameter

20   that will be propagated transparently through TDM network
section 140. In such information element or parameter, the
following information will be placed: an indication that
first packet network section 110 supports the inventive
method; an address, e.g. an IP address, of the controlling

25   device controlling the call in the first packet network sec-
tion 110, which in this case is first TDM gateway 116; and/or
a unique call reference for identifying the call in progress
in first gateway 116. It is understood that some of this in-
formation may be conveyed implicitly. For example, the pres-

30   ence of the address of the first packet network section con-
trolling device in such information element or parameter may
indicate that said controlling device is capable of the in-
ventive method so that a separate indication of this capabil-
ity may not be necessary.

35

Exemplary call setup messages are ISDN:SETUP or ISUP:IAM,
which both allow for a parameter called user-to-user informa-

tion (UUI) and/or an ISDN subaddress, which is conveyed in
ISUP using the application transport parameter (APP). These
information elements or parameters allow the "user", which in
this case is first gateway 116, to specify any information

5   for transport to another user, which in this case is second
gateway 126. When using the subaddress parameter, the infor-
mation to be transferred has to be encoded into numerical
format as the subaddress parameter only supports digits. Of
course, two or more transport mechanisms may be employed si-

10 multaneously to avoid loss of information in such case where
any TDM switch along the route through TDM network section
140 should discard either of said transport mechanisms. It is
understood that the information may be transported in the ap-
plication transport parameter (ATP) not only by way of subad-

15 dress, but also in any other form supported by the applica-
tion transport parameter (ATP).

In an alternative embodiment, said information element or pa-
rameter is conveyed using any message exchanged after the

20 initial call setup message.

In step 4, the information is transported in TDM network sec-
tion 140 transparently, in the preferred embodiment by means
of ISUP:IAM containing the application transport or user-to-

25 user information parameter.

In step 5, a terminating TDM node 144 sends a call setup mes-
sage to second TDM gateway 126 using any known TDM signaling
protocol such as ISDN, ISDN User Part (ISUP), or Telephone

30 User Part (TUP). This call setup message contains the infor-
mation element or parameter originally generated by first TDM
gateway 116.

In step 6, if second TDM gateway 126 is implemented in accor-

35 dance with the present invention, second TDM gateway 126 rec-
ognizes that first TDM gateway 116 is capable of the inven-
tive method. Second TDM gateway 126 extracts the information

from the information element or parameter, e.g. first TDM
gateway's IP address and call reference, and uses it for re-
questing an all-packet connection from second packet network
section 120 via second packet switching equipment 128, wide

5   area packet network 130, and first packet switching equipment
118 to first TDM gateway 116 in first packet network section
110. In this connection request, second TDM gateway 126 may
specify information such as its own capability set for nego-
tiating connection parameters, its own packet network ad-

10   dress, first TDM gateway's call reference, and its own unique
call reference for identifying the call in progress in second
gateway 126.

       In step 7, first TDM gateway 116 responds to the connection
15   request using, for example, a SIP:INVITE message.

       In step 8, the connection request is forwarded to second soft
switch 124, and more particularly, to a call agent residing
in second soft switch 124.

20
       In step 9, the connection request is presented to second sub-
scriber's terminal equipment 122.

       Upon acceptance of the incoming connection request, the call
25   may be established in step 10 in an all-packet fashion as in-
dicated by a dashed line.

       Optionally, the TDM call may be released at any time during
or after step 7 to release the resources utilized for the
30   call setup in TDM network section 140. If the call is not re-
leased an ACM message should be returned by TDM gateway 126
to TDM gateway 116 via TDM switch node 144 and TDM node 142.

       Fig. 2 depicts a network 100' which is essentially similar to
35   network 100 of Fig. 1. In Fig. 2, the capability to perform
the present invention does not lie in the TDM gateways 116A,

126A but instead is implemented in the soft switches 114A,
124A.

5   In the following, a sequence of events occurring in network
        100' will be described with reference to numerals 1'-10'. It
        shall be noted that numerals 1'-10' do not indicate a com-
        plete call flow but rather show general events, messages, and
        notifications that facilitate the inventive method.

10   The procedure again starts with subscriber A dialing sub-
        scriber B's PSTN directory number using, for example, a key-
        pad of first terminal equipment 112, which may be an IP en-
        abled telephone such as a SIP terminal.

15   In step 1', a corresponding setup message, for example a
        SIP:INVITE message, is generated and provided to first soft
        switch 114A by means of first packet network section 110.

        In step 2', a call agent residing in first soft switch 114A
20   requests the first TDM gateway 116A to establish a connection
        to TDM switch 142 and propagates the call setup to first TDM
        switch 142 via TDM gateway 116A, a separate signaling gateway
        (not shown) or via a Signaling Transfer Point (STP) (not
        shown). An STP interconnection between softswitch and TDM
25   switch may be optionally used to transfer SS7 call signaling
        when the soft switch directly provides SS7 interfaces. A sig-
        naling gateway may be optionally used to transfer SS7 call
        signaling when the soft switch does not provide SS7 inter-
        faces. Otherwise, TDM gateway 116A is used to relay the call
30   signaling.

        First soft switch 114A also, in Step 2', transfers the fol-
        lowing information to first TDM switch 142 for further trans-
        fer to second TDM switch 144 and second soft switch 124A: an
35   indication that first packet network section 110 supports the
        inventive method; an address, e.g. an IP address, of the con-
        trolling device controlling the call in the first packet net-

work section 110, which in this case is first soft switch
114A; and/or a unique call reference for identifying the call
in progress in first soft switch 114A. It is understood that
some of this information may be conveyed implicitly. For ex-
5   ample, the presence of the address of the first packet net-
work section controlling device in such information element
or parameter may indicate that said controlling device is ca-
pable of the inventive method so that a separate indication
of this capability may not be necessary.
10

In step 3', first TDM switch 142 receives a call setup mes-
sage generated by softswitch 114A from TDM gateway 116A, from
a separate signaling gateway (not shown) or from an STP (not
shown) using any known TDM signaling protocol such as ISDN,
15 ISDN User Part (ISUP), or Telephone User Part (TUP). TDM
switch 142 translates contained numbers and information for
routing and billing purposes. This call setup message con-
tains information elements or parameters that will be propa-
gated transparently through TDM network section 140. The in-
20 formation element transports the information provided by
first soft switch 114A.

Exemplary call setup messages are ISDN:SETUP or ISUP:IAM,
which both allow for a parameter called user-to-user informa-
25 tion (UUI) and/or an ISDN subaddress, which is conveyed in
ISUP using the application transport parameter. These infor-
mation elements or parameters allow the "user", which in this
case is first gateway 116A, to specify any information for
transport to another user, which in this case is second gate-
30 way 126A. When using the subaddress parameter, the informa-
tion to be transferred has to be encoded into numerical for-
mat as the subaddress parameter only supports digits. Of
course, two or more transport mechanisms may be employed si-
multaneously to avoid loss of information in such case where
35 any TDM switch along the route through TDM network section
140 should discard either of said transport mechanisms. It is
understood that the information may be transported in the ap-

plication transport parameter (ATP) not only by way of subaddress, but also in any other form supported by the application transport parameter (ATP).

5   In an alternative embodiment, said information element or parameter is conveyed using any message exchanged after the initial call setup message.

In step 4', the information is transported in TDM network
10   section 140 transparently, in the preferred embodiment by means of ISUP:IAM containing the application transport or user-to-user information parameter.

In step 5', a terminating TDM node 144 sends a call setup
15   message to second TDM gateway 126A, a second signaling gateway (not shown) or a second STP (not shown) using any known TDM signaling protocol such as ISDN, ISDN User Part (ISUP), or Telephone User Part (TUP). This call setup message contains the information element or parameter originally gener-
20   ated by first TDM gateway 116A.

In step 6', second TDM gateway 126A, second signaling gateway (not shown) or second STP (not shown) forwards the call setup request and the information element to second soft switch
25   124A.

In step 7', if second soft switch 124A is implemented in accordance with the present invention, second soft switch 124A recognizes that first soft switch 114A is capable of the in-
30   ventive method. Second soft switch 124A extracts the information from the information element or parameter, e.g. first soft switch's IP address and call reference, and uses it for requesting an all-packet connection from second packet network section 120 via second packet switching equipment 128,
35   wide area packet network 130, and first packet switching equipment 118 to first soft switch 114A in first packet network section 110. In this connection request, second soft

switch 124A may specify information such as its own capability set for negotiating connection parameters, its own packet network address, first soft switch's call reference, and its own unique call reference for identifying the call in pro-
5   gress in second soft switch 124A.

In step 8', first soft switch 114A responds to the connection request using, for example, a SIP:INVITE message.

10   In step 9', the connection request is forwarded to a call agent residing in second soft switch 124A, which then presents the connection request to second subscriber's terminal equipment 122.

15   Upon acceptance of the incoming connection request, the call may be established in step 10' in an all-packet fashion as indicated by a dashed line.

Optionally the TDM call may be released at any time during or
20   after step 8' to release the resources utilized for the call setup in TDM network section 140. If the call is not released an ACM message should be returned by the second soft switch 124A to first soft switch 114A via TDM network 140 including both TDM switch node 144 and TDM node 142.
25
In other embodiments of the invention, the teachings of the embodiments according to Figs. 1 and 2 may be combined such that the inventive method is controlled in a TDM·gateway in either of the packet network sections and a soft switch in
30   the other.

In some applications, it may be desirable to complete the TDM call setup and also establish a TDM connection in accordance with known methods. This can easily be accomplished by omit-
35   ting the optional step of releasing the TDM connection.

From the foregoing detailed description it will be obvious to those with skills in the art how to apply the principles of the present invention to select other suitable controlling devices in packet network sections for controlling the inven-

5   tive method.

While the invention has been described using the session ini-tiation protocol SIP as an exemplary packet network protocol, other protocols may be employed without departing from the

10   spirit of the present invention. Also, while

It will be appreciated that the teachings of the present in-vention apply in various other network arrangements includ-ing, but not limited to, network arrangements including a

15   large number of subscribers, which may also be mobile, and/or network arrangements wherein the wide area packet network and either or both packet network sections form one unique net-work.